King Fire Restoration Project

Background

The King Fire started September 13, 2104 and burned approximately 97,000 acres on the Eldorado National Forest and on private timberlands. The project area for this analysis is the approximately 63,000 acre portion of the King Fire on Eldorado National Forest lands within the Georgetown, Pacific, and Placerville Ranger Districts administrative boundary. The project area includes all or portions of 30 watersheds.

Restoration efforts need to balance short- and long-term risk and objectives to achieve ecological integrity, which is the quality or condition of an ecosystem's dominant ecological characteristics to occur within the natural range of variation and withstand and recover from most natural or human perturbations. There are numerous studies documenting the historical occurrence of frequent, low severity fires in mixed conifer forests throughout the Sierra Nevada (North 2012). Collectively, these studies suggest that historical forests had a low incidence of high-severity fire, and that high severity patch sizes in yellow pine/mixed conifer forests more than a few acres in size were uncommon. The few large patches noted in a recent study were in the range of one hundred fifty to two hundred twenty acres in size (Collins and Stephens 2010). Recently, high severity patches of thousands of acres have become common such as in the King Fire where the largest conifer dominated high severity patch exceeded 10,000 acres in size. The percentage of high severity fire and the high severity patch sizes in the King Fire far exceed the natural range of variability.

Table 1. Basal Area Mortality of Trees within the King Fire

Basal Area Mortality	Private Land Acres	National Forest Land Acres	Total Acres (Percent)
0%	8866	16264	25130 (26%)
0%-<10%	3064	6351	9415 (10%)
10%-<25%	1391	3181	4572 (5 %)
25%-<50%	1551	3500	5051 (5%)
50%-<75%	1407	2856	4263 (4%)
75%-<90%	1081	1903	2984 (3%)
≥90%	16184	29358	45542 (47%)
Total	**33543**	**63414**	**96957**

The large high severity portions of this fire resulted in adverse effects to forest resources such as soil, riparian areas, and wildlife habitat, and killed thousands of trees which will contribute to hazardous conditions for people and extremely high fuel loading over time. The objectives of this project are to maintain the ecological integrity of post fire habitat; reduce future fuel loadings in strategic areas important to fire control; increase resiliency of growing forest to future fire; reduce safety hazards to people and risks to buildings, infrastructure and cultural resources; recover some of the economic value of dead trees to in order to offset the cost of restoration activities and contribute to societal needs for wood products; take advantage of opportunities for research to increase knowledge regarding effects on the environment from large fires; and reduce sediment to streams and large woody fuel accumulation in sensitive areas. The long term goal for the fire area is to move toward desired future conditions as defined by the Sierra Nevada Forest Plan Amendment (SNFP) (USDA 2004).

After the King Fire Restoration Project decision is made, the Forest Service expects to engage in further restoration and rehabilitation activities within the King Fire area. For example, the agency may contemplate future projects to address ecosystem restoration and resilience such as prescribed fire or additional fuels treatments, and additional watershed protection projects that may be identified. Such future actions will help contribute to the recovery and restoration of the area burned by the King Fire, taking advantage of the work done through this project and building on it. However, the planning process for such actions has not begun. Because the King Fire Restoration Project has independent utility and will proceed regardless of whether future agency actions occur within the King Fire area, the future actions and this project are not connected actions under Council of Environmental Quality's (CEQ) National Environmental Policy Act (NEPA) regulations.

Purpose and Need for Action

The underlying needs for this proposal are:

1. **Reduce the risk from falling dead, dying, and defective trees that pose a significant safety concern for forest visitors and workers, and of damaging private property, infrastructure and cultural resources**: There are roads and infrastructure within the project area, and private residential property, homes and structures adjacent to National Forest land. Dead and defective trees next to roads and residential property pose significant safety risk to people and property as they deteriorate and fall. In addition, natural tree fall within cultural resources sites years after wild fires can cause considerable damage.

2. **Reduce accumulation of fuel over the long term in strategic fire management areas for the purpose of improving the ability to manage and control future fires:** In areas where the fire intensity was moderate to high, surface fuel loading is very low. As dead trees fall and shrubs sprout, surface fuels will increase significantly, affecting future fire behavior and leading to difficulty in suppressing wildfires. Fire line construction is significantly slowed where fire lines intersect numerous large logs. This is referred to as "resistance to control" and can lead to larger fires. Excessive large woody fuel accumulation increases flame lengths and fire line intensity,

affecting the ability to suppress the fire and the ultimate fire size. High snag numbers contribute to long range spotting and risk to firefighter safety. The combination of snags and surface fuels would eventually limit the ability of firefighters to safely and effectively control future wildfires, particularly in the wildland urban interface defense zone and other strategic locations that could be used for future fire suppression actions.

3. **Restore diverse vegetation including conifer forests and lay the foundation for resiliency into the future:** Restoration efforts need to balance short- and long-term risk and objectives to achieve ecological integrity by protecting soil, water, and native plant communities, and leaving a sufficient number and distribution of dead trees to provide habitat and other important ecological functions without generating excess future fuels and potentially reducing survival of young forests following fire. High fire severity patches in yellow pine/mixed conifer forests more than a few acres in size were uncommon in pre-settlement forests. Reforestation can be important to maintaining forest ecosystems and deriving associated ecological and social benefits, however the ability of trees to regenerate naturally after fire is highly dependent on distance to seed sources. In large areas of the King Fire, conifer seed sources are absent; therefore tree planting is needed to restore forests in the near term. Efforts at reforestation which consider whether the growing forest will be sustainable and resilient into the future in the face of wildfire and changing climate are needed. A restoration objective is to establish forest species diversity and resilience at multiple scales by considering the mosaic of complex early seral forest habitat, tree species, arrangement and density of trees, landscape position, and large woody fuel accumulation. There is a need to consider the ability to manage the future forest using prescribed fire and mechanical treatments in reforested areas. In addition, deteriorating dead trees pose a continuing hazard to workers as they implement restoration projects within the fire area, and contribute to high fuel loading over time.

4. **Expeditiously recover timber killed by the fire commensurate with available markets, for the purpose of generating funds to offset the cost of restoration activities and contribute to societal needs for wood products:** Dead trees deteriorate rapidly relative to wood merchantability, quality and value. If removed within one year of the fire, the value of the dead trees would pay for their removal from the forest and potentially pay for other future restoration treatments, such as road repair, reforestation, treatment of additional fuels, and watershed and wildlife habitat enhancement. The value and merchantability of these trees is short lived, and will continue to decline over time. Smaller diameter trees deteriorate faster than large trees; by the second year after the fire, 47% to 74% of the volume of trees less than 24 inches diameter is lost and the value of larger dead trees is reduced due to effects from fungi and insects. (Lowell et al. 1992).

5. **Take advantage of research opportunities to increase knowledge regarding the effects of large fires on the environment, how to reduce the risk of future fires, and how to restore resilient forests after fires:** Research opportunities to study effects of large, high intensity fires and restoration treatments on wildlife, conifer seed dispersal, tree recruitment, soil erosion, aquatic

resources, and fuel accumulation are abundant within the King Fire perimeter. The Eldorado National Forest is working with scientists from Pacific Southwest Research Station (PSW) and several Universities to take advantage of the opportunity that a fire of this scale and intensity provides to add to our knowledge base about the potential effects of management of burned forests to achieve long-term resilience, and the conservation of native plants and animal species associated with these habitats.

6. **Reduce existing and potential sources of soil movement and sedimentation to streams, and reduce large woody fuel accumulation in sensitive areas where a future fire is likely to have detrimental effects on soil, water, natural and cultural resources:** In areas of moderate and high severity fire, there are opportunities to reduce existing sources of sediment to streams from roads and previous ground disturbance. In addition, timber stands in areas of high fire severity are at risk of accumulating high surface fuel loads as fire killed trees fall to the ground. In a future fire, high surface fuel loads can lead to increased soil temperatures and longer fire residence times, which can negatively impact soil, aquatic resources, and cultural sites. Excessive large woody debris also limits future vegetation and landscape management options.

Proposed Action

The following was taken into consideration in developing the proposed action:

- The focus is in areas that burned with high fire severity that are outside the natural range of variability (NRV) for fire patch size. The NRV of high fire-severity patches documented in the scientific literature for Sierra Nevada Ponderosa pine and mixed conifer forests was strongly dominated by a “salt-and-pepper” pattern of small areas less than a few acres in size. Larger patches did occur, but they rarely exceeded 250 acres in size. Within the King Fire, all high severity patches smaller than 10 acres were considered to be within the NRV and included in the proposed action only where needed to address hazard tree removal. Assuming some larger patches were common, a number of these were excluded from proposed treatment across the landscape as well.

- Current pre-fire vegetation maps and the Wieslander composition data, which are maps from the 1920s and 1930s representing a snapshot of California's vegetation in the early 20th century, were used to identify hardwood/chaparral/grasslands areas. These were excluded from proposed action with the consideration that these areas would continue to persist into the future, such as the south facing slopes along the South Fork of the American River.

- Consideration was given to maximizing the probability of California spotted owl persistence within and adjacent to the King Fire, maintaining habitat suitable for fire obligate wildlife including the black-backed woodpecker, promoting a mosaic of post-fire vegetation important for species associated with early seral habitats, and minimizing impacts to the threatened Sierra Nevada yellow-legged frog and California red-legged frog (CRLF).

- Current scientific literature that indicates seed dispersal generally occurs within one to two tree heights, or 60 meters (200 ft.), and long distance dispersal has been documented at 400 meters (1300 ft.) was considered (Bonnet et al. 2005; Bohlman 2014). For the reforestation proposed action, a statistical analysis using 100 meter (328 feet) estimate of seed dispersal to estimate the probability of natural regeneration was completed. Unburned, low and moderate severity conifer burn areas were used as proxies for seed sources, which were weighted as 3, 2, and 1 to reflect theoretically more seed sources in the unburned, low, moderate categories. These areas were then identified as potential for natural regeneration and excluded from proposed tree planting. Areas that were smaller than 10 acres were identified and also excluded.

- A fire modeling and fuel treatment strategy was completed that identified wildland urban interface (WUI) defense zones where the focus is on protecting life and property, and strategic fuel management zones to contain wildfires and facilitate prescribed fire.

- Topographic analysis was conducted to generally eliminate steep slopes from the proposed action where treatments would be prohibitively expensive, and where treatment was not needed to meet other objectives of the project. One such area is within the slopes above the Rubicon River.

- The 2-Chaix Fuels Reduction and Forest Health Project is a previously approved project wholly encompassed by the King Fire (USDA 2012). The 2 Chaix project consists of thinning of commercial size trees and biomass, mastication, prescribed burning, and road repair. Due to the substantial changed conditions wrought by the fire, this environmental impact statement constitutes a complete revision to the *2 Chaix Fuels Reduction and Forest Health Environmental Assessment*, with the exception of road work already completed. Except as noted, the proposed action herein would replace the actions described in the 2-Chaix EA and Decision Notice.

The proposed action includes the following areas to be treated, activities and methods along with the design criteria described on the following pages:

Areas identified for treatment include (refer to Tables 2.1 and 2.2 below): WUI defense zones where increasing fuel loads pose a hazard to community fire protection; strategic fire management zones which include areas identified to establish a safe and effective place for future fire suppression; forest resiliency areas where reestablishment of conifer forests is desired, ecologically sustainable, and can be managed to have a high probability of surviving subsequent wildfire; and other specific areas where treatment would occur for hazard removal, research and watershed improvement (specific areas pending field review); and roads needing hazard tree removal, repair, closure, and/or decommissioning.

Table 2. Areas identified for treatment in the Proposed Action

Area Proposed for Treatment	**Approximate Acreage[1]**
Wildland Urban Interface Defense Zones	1,160
Strategic Fire Management Zones	7,270
Forest Resiliency Areas	5,510
Total	**13,940**

[1]Acreage may be adjusted subject to field verification

WUI Defense Zones, Strategic Fuels Management Zones, and Forest Resiliency Areas: Remove dead conifer trees in excess of soil cover needs and wildlife snag retention levels needs. In the Forest Resiliency Areas, snags will generally be retained in two to five acre patches covering 15 to 20 percent of a treatment area and incorporating the largest snags available. No standing snags will be retained in WUI Defense Zones, and four large snags per acre up to 12sq. ft./acre basal area in a grouped configuration will be retained in Strategic Fire Management Zones. Trees to be removed have brown foliage or no foliage remaining as viewed from the ground. Mortality monitoring for tree removal may be conducted up to 4 years following the fire.

Hazard Areas: Remove hazard trees along Forest Service system roads open to the public and roads needed for access to treatment areas, along private residential property, adjacent to structures, and in specific cultural resource sites identified by the archeologist. Hazard trees to be removed are dead and dying trees that have potential to reach the road or property and live trees that are sufficiently damaged or defective to pose a risk of falling within the next 5 years. Dying trees would be identified using the publication *Marking Guidelines for Fire-Injured Trees in California* (Smith and Cluck, 2011) at a 70% probability of mortality. Live damaged and defective trees would be identified using the publication *Hazard Tree Guidelines for Forest Service Facilities and Roads in the Pacific Southwest Region* (Angwin et al. 2012).

Table 3. Miles of roads within the project area subject to hazard tree removal

Road Maintenance Level	Road Mileage Within Fire Area to be Considered for Hazard Tree Removal[1]
1- Basic Custodial Care (Closed to Public Use)	30
2- High Clearance Vehicles	296
3 – Suitable for Passenger Cars	37
4 – Moderate Degree of User Comfort	33
Total	**429**

[1]mileage to be treated for hazard tree removal will depend on whether or not hazard trees are present

Logging Methods and Machinery: The following methods would be utilized as applicable in areas described above for treatment:

- On slopes generally less than 35% and subject to exclusion zones described in the design criteria, methods of tree removal would include mechanized logging that generally utilize feller bunchers and rubber tired or track mounted log skidders; cut-to-length systems that utilize an in woods tree processor and log forwarder; conventional logging systems that employ timber fallers with chainsaws and rubber or track mounted log skidders; and logging with a heel-boom or excavator mounted log loader (commonly referred to as “shovel or heel boom” logging).

- On slopes generally exceeding 35%, methods of tree removal would generally be aerial logging with a skyline system or helicopter. In areas identified by the soil scientist and/or hydrologist that are suitable, shovel logging may be considered. Skyline machinery would operate from roads and helicopters would base from log landings and service landing areas. Shovel or heel boom loaders would operate within areas designated by the Forest Service.

- Log landings and decking areas would generally employ one or more of the following: log loaders, chainsaws, tree processors, chippers, log trucks, fuel trucks, and chip vans. Helicopter service landings would generally be rocked with aggregate base and employ service vehicles and fuel trucks or other fuel storage containers. Fuel would be stored in areas designated by the Forest Service away from any risk of stream contamination.

Fuel Treatment: In areas identified above to be treated, the maximum desired surface fuel loading is 6-10 tons per acre of material <3” diameter. It is expected that this level would be achieved using the logging methods described above. However, in areas described above where additional treatment is needed to reduce fuel loading to the desired level or provide additional soil cover, tops, limbs, and unmerchantable boles of harvested trees, and small dead trees that are not removed using the logging methods described, would be treated by one or more of the following methods: cutting and scattering to within 18 inches of the ground, cutting and left in place, hand piling, mastication or chipping with a track mounted masticator or chipper; and/or cutting trees and piling using tractors or rubber tired machinery with brush rakes or grapples. Piles would be burned.

Table 4. Methods of treatment and approximate acreage

Methods	Approximate Acres [1]
Mechanical or Ground Based Logging	11,720
Aerial Logging	720
Hand Treatments	670
Mastication or Piling without Logging	120
Tree Planting/release without Logging (see below)	710
Total	**13,940**

[1]Acreage may be adjusted subject to field verification

Watershed Sensitive Areas (WSAs): Portions of watersheds determined to be at high risk of soil erosion and sedimentation which could negatively impact watershed resources. Criteria for delineating and evaluating WSAs include: high existing disturbance density, potential to impact water quality and riparian habitat, burn severity, slope steepness, shape and length, existing and potential soil cover, proximity to riparian-associated sensitive species and proximity to drainages and high runoff soils. Specific locations are pending field review. Treatments include increasing groundcover using onsite or imported material (e.g. mastication, lop and scatter, mulching), obliteration of existing disturbances, and removal of excess woody material.

Roads: Improve existing road conditions to reduce erosion and facilitate forest product removal. Road repair and improvement includes outsloping, clearing debris and surface grading, culvert replacement or installation, installation of drivable dips and waterbars, slipout repair, application of aggregate surfacing, and waterhole repair.

Construct no new system roads. Temporary roads may be constructed to access landings. Following use, any cut or fill slopes will be reshaped into surrounding slope and temporary roads will be scarified, drained, and blocked to vehicular traffic.

Reforestation: Planting of seedlings would occur on approximately 13,940 acres of conifer forest types where a forested community is the desired condition, but where natural regeneration of a desired species composition and density are not expected to occur within the next several decades, and where stands can reasonably be effectively and efficiently managed into the future. Planting strategies would be designed to maintain ecological integrity while balancing future climate projections, economics, long-term management feasibility, and desired conditions.

Guiding principles of reforestation:

- Accelerate the development of large trees including a high percentage (>50%) of fire-tolerant pines;

- Design planting and follow-up treatments to create an individual, clump and opening pattern described for low-intensity, frequent fire forests (Larson and Churchill 2008, Larson and Churchill 2012, Churchill et al. 2013);
- Planting would be done to establish a future tree density which would be consistent with historic forest conditions that may be more resilient to drought and low-moderate fire intensities (roughly 40-120 trees/ac);
- Vary planting pattern, species composition and density based on topography, land allocation and site class;
- Allow for moderate levels of shrub cover (roughly 10-30%) and high native herbaceous cover interspersed within an identified reforestation area;
- Favor rapid development of fire-resistant stand structure (encourage crown rescission and separation of shrub cover and tree foliage) so that use or occurrence of fire within this landscape results in acceptable survival of plantation stands within a 15 year timeframe;
- Prioritize planting areas furthest from live-tree seed sources and productive sites with potential lower fire intensities (i.e., moist, flatter and cool-air microsites);
- Evaluate opportunities for planting of obligate riparian shrubs and trees in areas where natural recovery is not anticipated to occur;
- Employ strategies to minimize invasive plant spread during reforestation.

In the majority of planted areas, clusters of 3 to 5 closely spaced trees would be planted 21 to 33 feet apart with species composition, densities and spacing varied by slope, aspect, and landscaped position based on forest stand structure concepts in PSW-GTR 220 and PSW-GTR 237 (North et al 2009; North, ed. 2012). Planting density and arrangement would consider site potential, survival probability, and likely future treatments to appropriately capture microsites within stands so that future stands are reasonably assured to achieve the target density of desired residual trees.

Planted trees would include a diverse genetic stock of Sierra Nevada Mixed Conifer Forest tree species informed by seed zone, seed sub-region, and climatic information. For sugar pine, only rust resistant seedlings would be planted.

Except in the limited circumstances where site preparation to treat residual fuels is not needed, salvage logging would be completed before planting takes place. At the time of planting, the planted seedlings would be released from competing vegetation by hand scraping a radius of 2 to 5 feet around the seedlings depending on competing vegetation and follow-up treatment planned.

Follow-up manual and herbicide release of seedlings from competing vegetation would occur where competing vegetation is expected to reduce seedling survival or growth below an acceptable level. Woody vegetation (shrubs and hardwoods) has generally been considered as the most competitive type of vegetation in young conifer plantations. Some herbaceous species also can reduce the survival of planted trees in certain circumstances.

- Manual release of seedlings from competing vegetation would involve hand cutting (grubbing) competing vegetation up to a 5 foot radius from planted and desired natural seedlings in areas where herbicide application is restricted or where competing vegetation is expected to be effectively and efficiently controlled using manual release methods.
- Herbicide would be applied as a spot or radial release treatment around seedlings where shrub cover is expected to exceed 30% in order to maintain shrub levels below that density for at least a decade.

Dense shrub cover would be retained in strategic buffers or patches where a barrier could reduce invasive plant spread (along roadsides, unit boundaries, around existing infestations, adjacent to private property).

Herbicides proposed for targeted plant control would use ground based application with a directed low-pressure spray. Backpack sprayers would be used to apply spray in sweeping motions. With the method proposed, the herbicide is released through a handheld wand with a trigger that is controlled by the applicator. The spray would be applied directly to targeted plants and spraying would be stopped when moving between plants. A low nozzle pressure (15 psi) that produces a relatively large droplet would be required. A pressure gauge or a pressure regulator would be required on backpack sprayers. Prior to the start of application, all spray equipment would be calibrated to insure accuracy of delivered amounts of pesticide. Periodically during application, equipment would be rechecked for calibration.

Additives in the form of colorants and adjuvants would be added to the herbicide mixtures. A colorant would be added to assist in the inspection process to determine the location of coverage. An adjuvant or surfactant would be used to help the herbicide mixture be absorbed into the plant.

Table 5. Herbicide Chemical Formulation, Application Rate, and Additives

Herbicide	**Trade Names**	**Target Species**	**Timing**	**Proposed Application Rate**
Glyphosate	Rodeo or equivalent	deer brush, scotch broom, green leaf manzanita, choke cherry, whitethorn, chinquapin, tanoak, bracken fern, bear clover	when target plants are actively growing	2 to 8 lb. a.e./acre
Adjuvant		**Trade Names**		
Spreader-Penetrator		Syl-Tac, Hasten or Competitor (aquatic formulation)		
Marker Dye		Hilight Blue or Colorfast Purple		

Areas identified for planting generally avoid areas of desired snag retention, however, where necessary, standing snags posing a safety hazard to planting and release crews could be felled, lopped, and scattered in place to provide a safe working environment.

Research:

1. **Effect of varying salvage and re-planting intensities on the fuel complex and native/ non-native species abundance over time.** Principal investigators are Eric Knapp, Malcolm North, Morris Johnson, and Martin Ritchie.

   The purpose of this research is to evaluate treatments of varying levels of salvage within the King Fire, in order to address the following questions:

   - How long do fire-killed trees remain upright as snags?
   - How does the rate at which snags become fuel vary with tree species, tree size, and other local factors?
   - Do salvage operations affect overall understory biodiversity and does logging disturbance facilitate invasion by non-native species?
   - Do salvage operations positively or negatively affect rates of natural tree regeneration?
   - How does different spacing of planted tree regeneration affect tree survival, growth and resilience of the stand to future fire?

   Results of this study will improve our understanding of the longevity of snags, and the effect of salvage on fuel loading and understory development. Results will also provide information about replanting patterns that could reduce maintenance costs while simultaneously improving stand resilience.

2. **Forest resilience after high-severity wildfire: the effect of snag density and distribution on the retention of forest ecosystem functions.** Principal investigators are Pat Manley, Angela White, Brandon Collins, and Malcom North.

   The primary focus of this research project is to determine how the distribution and density of dead trees across severely burned areas affects the ability of the burned landscape to support core functions. In other words, does salvage logging impact the ability of landscapes to support core functions, and if so, what densities of dead trees are required to support core functions of greatest interest. One of the challenges of leaving snags in salvaging a high severity post-burn landscape is the potential danger and difficulty in working around snags. Dead trees are often left in clumps to reduce risks and facilitate freedom of movement within units. Specifically, the research is designed to answer the following questions:

- How does the density of dead tree patches and proximity to live trees effect the abundance and diversity of plants and animals recolonizing high-severity landscapes? Does this relationship change in areas that have been harvested for salvage?
- How does understory plant and tree regeneration decrease as the distance to green forest edge increases? Does this relationship change in areas that have been harvested for salvage and/or dead tree abundance and distribution?

- To what degree do physical features affect dispersal success, including aspect, slope, and prevailing wind direction
- To what degree do site conditions affect use/establishment, including snag densities and characteristics, fine and coarse woody debris, soil quality, aspect, slope, microclimate, and other substrates
- How do surface fuel loads vary as a function of salvage treatment and distance to green forest edge? Is there a relationship between surface fuel loads and understory plant/tree regeneration? How does variation in surface fuel loads influence use of burned habitat by wildlife?

Additional research proposals are pending.

Design Criteria for the Proposed Action

The Forest Service also developed the following design criteria to be used for the proposed action. Additional design criteria for these and other resources are being developed and will be incorporated as needed.

Aquatic Biological Resources: The following measures are designed to minimize impacts to aquatic wildlife and resources:

1. If a sensitive or listed amphibian or turtle is sighted within the project area, cease operations in the sighting area, and inform a Forest Service aquatic biologist of the sighting immediately. Before commencing activities, consultation may need to be re-initiated with United States Fish and Wildlife Service.
2. Mechanical operations will not occur within 1 mile of areas identified as suitable California red-legged frog breeding habitat during the wet season (defined as starting with the first frontal rain system that deposits a minimum of 0.25 inches of rain after October 15 and ending April 15).
3. Maintain a 30-foot no harvest and no equipment buffer around areas identified as suitable California red-legged frog aquatic habitat (breeding and non-breeding). Otherwise, a qualified biologist will perform a visual encounter survey 24 hours before project implementation. If CRLF are detected, establish a 300 foot buffer from the high water mark where no project activities will occur; consultation with the USFWS would be re-initiated.
4. In suitable Sierra Nevada yellow-legged frog (SNYLF) habitat (100 ft. from perennial and intermittent streams and special aquatic features) without existing aquatic surveys, trees may be felled to abate hazards but will be left in place to avoid further site disturbance. If removal of the tree is necessary, a qualified biologist will perform a visual encounter survey 24 hours before project implementation. If SNYLF are detected consultation with the USFWS would be re-initiated.

5. Locate roads and landings at least 300 feet away from suitable California red-legged frog breeding and non-breeding aquatic habitat. Construction within 1 mile of suitable habitat must occur during the dry season (typically April 15 through October 15).
6. Do not locate burn piles within 100 feet of suitable California red-legged frog aquatic habitat (breeding and non-breeding), or Sierra Nevada yellow-legged frog habitat.
7. When igniting hand piles within 1 mile of suitable California red-legged frog breeding habitat, within 100 feet of Sierra Nevada yellow-legged frog and foothill yellow-legged frog habitat, and within 300 feet of occupied western pond turtle habitat, ignite only on one side, not to exceed half the circumference of the pile, on the side furthest from the nearest aquatic feature.
8. Ensure California red-legged frog cover is provided in the potential upland habitat. Consultation between the Forest Service project administrator and an aquatic biologist will occur during harvest. If the area is found to be deficient in downed material, cut and lop dead trees 8 to 16 inches diameter breast height uniformly across the landscape at a rate of 3 to 5 tons per acre.
9. No herbicide application within 500 feet of known occupied California red-legged frog habitat or within 100 feet of suitable Sierra Nevada yellow-legged frog habitat.
10. Follow any additional site specific Management Requirements provided by the Fish and Wildlife Service within their Biological Opinion for this project.
11. Water drafting sources shall be chosen in consultation with a hydrologist and aquatic biologist prior to using. An aquatic biologist will assess or survey the water drafting sites for sensitive and listed species prior to using. If sensitive, threatened or endangered species are identified at a potential water drafting site, that site would not be used for water drafting.
12. Pump intake screens shall have openings not exceeding 3/32 inch (0.09375 inch) and be sized according to the pump intake capacity. Place hose intake into bucket in the deepest part of the pool. Use a low velocity water pump and do not pump ponds to low levels beyond which they cannot recover quickly (approximately one hour).
13. For water drafting on fish-bearing streams: do not exceed 350 gallons per minute for stream flow greater than or equal to 4.0 cubic feet per second (cfs); do not exceed 20% of surface flows below 4.0 cfs; and, cease drafting when bypass surface flow drops below 1.5 cfs.
14. For water drafting on non-fish-bearing streams: do not exceed 350 gallons per minute for stream flow greater than or equal to 2.0 cfs; do not exceed 50% of surface flow; and, cease drafting when bypass surface flow drops below 10 gallons per minute. Water sources designed for permanent installation, such as piped diversions to off-site storage, are preferred over temporary, short-term-use developments. Locate water drafting sites to avoid adverse effects to in-stream flows and depletion of pool habitat.
15. Design permanent stream crossings (new construction and replacement culverts) to pass the 100-year flood flow plus associated sediment and debris; armor to withstand design flows and provide desired passage of fish and other aquatic organisms.

Botanical Resources: following are measures designed to minimize impacts to sensitive and watchlist plants, and minimize infestations of invasive plants. Botanical surveys of treatment areas would be conducted prior to project implementation. Occurrences of sensitive, watchlist, and invasive plants discovered prior to or during project implementation would be flagged and the following design criteria would apply:

1. Flag occurrences of sensitive and watchlist plants. No staging, vehicle traffic, heavy equipment travel, skidding, lop and scatter, or piling would occur within flagged areas. Fall trees away from flagged areas wherever possible. Exceptions are provided below:
   a. A Forest Service botanist will be present during implementation activities occurring within sensitive plant occurrences.
   b. With approval by the botanist, fire-killed or hazard trees rooted within flagged occurrences of Calochortus clavatus var. avius (CACLA), Horkelia parryi (HOPA), Navarretia prolifera ssp. Lutea (NAPRL), Phacelia stebbinsii (PHST) and watchlist species may be cut and removed if mechanical ground disturbance can be eliminated (e.g. removal by equipment with an articulating arm which allows for full suspension while operating from outside the flagged area; hand felling trees and removal with full suspension). The botanist will review the site with the Forest Service project administrator to determine the least impactful method to use for the site.
   c. Lop, scatter, and mastication to meet ground cover and fuel reduction objectives may occur within CACLA, HOPA, and all watchlist occurrences. Wherever possible, reach into occurrences with masticator head to conduct the work instead of tracking through. Minimize use of tracked equipment within the occurrence. Masticated material should be spread to a depth of less than 2” thick and less than 70% ground cover, or be spread outside of the occurrence.
2. No project activities within the Leonardi Springs Botanical Special Interest Area and Lava Cap Study Plots.
3. Retain a buffer of live or dead shrubs and standing or downed snags around Arctostaphylos nissenana (ARNI) sites and “lava cap” habitats to discourage motorized access. If deemed necessary by the botanist, install barriers at these sites where there is an increased threat of vehicle intrusion due to loss of screening vegetation and snags.
4. Directionally fell trees away from lava caps. No piling or lop and scatter within lava caps. All project related equipment and vehicles will remain on existing road corridors within lava caps; no parking off road, staging, or landing construction within lava caps.
5. Generally retain oak trees and oak saplings (live and top-killed). To mitigate hazards to roads or infrastructure, prune branches instead of felling the entire tree wherever possible.
6. Retain all surviving proven and candidate rust-resistant sugar pine trees during project operations.
7. Reforestation activities would not occur within sensitive and watchlist plant sites, un-surveyed suitable habitat, or lava caps.
8. Glyphosate for brush control would not be applied within 50’ of sensitive or watchlist plants to minimize impacts from drift or misapplication. Reductions in buffer width would be approved by the FS botanist.

9. Piling with tractors is not permitted in sensitive or watchlist plant sites or lava caps. Where necessary, hand fire line may be constructed if approved and directed by the FS botanist.
10. Flag and avoid high-priority invasive plant infestations. No staging, heavy equipment travel, skidding, or piling would occur within flagged areas. Fire-killed or hazard trees rooted within flagged infestations may be cut and removed if mechanical ground disturbance can be eliminated.
11. Treatments to reduce risk of spread of invasive plants prior to project implementation would be identified by the botanist. Mechanical or chemical treatments would be conducted in accordance with the design features of the *Forest-Wide Treatment of Invasive Plants Project* (ENF 2013). Torching or prescribed burning may be utilized if determined to be the most effective method of treatment.
12. Reforestation activities would not occur within a buffer around high-priority infestations identified by the FS botanist.
13. Where possible, work in units with invasive plant infestations last. If working in infestations or infested units, equipment shall be cleaned before moving to other uninfested National Forest system lands. These areas will be identified on project maps.
14. Equipment and vehicles (Forest Service and contracted) used for project implementation must be free of invasive plant material before moving into the project area. Equipment will be considered clean when visual inspection does not reveal soil, seeds, plant material or other such debris.
15. All gravel, fill, or other materials used for road construction are required to be from sources certified as weed-free or approved by the botanist.
16. Erosion control materials are required to be certified weed-free. Utilize on-site biomass to generate ground cover materials wherever possible. Seed or plant mixes for erosion control re-vegetation or restoration must be approved by the project botanist.
17. As project activities are completed, monitor for new or expanding invasive plant infestations. If necessary, treatments would be conducted in accordance with the design features of the *Forest-Wide Treatment of Invasive Plants Project* (ENF 2013).

Riparian Conservation Areas: following are measures designed to protect water quality and aquatic habitat within stream environments.

Table 6. Operating requirements for ground based mechanized equipment in Riparian Conservation Areas (RCAs)

Habitat Type[1]	Zone	Width (feet)	Equipment Requirements	Operating Requirements
Perennial/ Intermittent and Special Aquatic Features (SAFs)	Exclusion	0 to 100 feet; or 0 to 25 feet beyond riparian vegetation, whichever is greater	Prohibited: Mechanical Harvesting/ Shredding[2] and Skidding[3]	Equipment reach in may be allowed upon consultation with RCA team[4]. Removal of logs by full suspension only.
	Outer Perennial and SAFs	100 to 300 feet; or 25 feet beyond riparian vegetation to 300 feet	Allowed: Mechanical Harvesting/ Shredding[2] and Skidding[3]	Ground based equipment operations prohibited on slopes greater than 25%. Use existing skid trails except where unacceptable impact would result. Do not construct new primary skid trails or landings within RCAs without consultation with the RCA Team.
	Outer Intermittent	100 to 150 feet; or 25 feet beyond riparian vegetation to 150 feet		
Ephemeral	Exclusion	0 – 10 feet	Prohibited: Mechanical Harvesting/ Shredding[2] and Skidding[3]	
	Transition	10 – 25 feet	Allowed: Equipment reach in	Removal of logs by full suspension only.
		25 – 50 feet	Allowed: Mechanical Harvesting/ Shredding[2] Prohibited: Skidding[3]	
	Outer	50 – 150 feet	Allowed: Mechanical Harvesting/ Shredding[2] and Skidding[3]	Ground based equipment operations prohibited on slopes greater than 25%. Use existing skid trails except where unacceptable impact would result. Do not construct new primary skid trails or landings within RCAs without consultation with the RCA Team.

[1] Perennial streams flow year long. Intermittent streams flow during the wet season but dry by summer or fall. Ephemeral streams flow only during or shortly after rainfall or snowmelt. Special aquatic features (SAFs) include lakes, ponds, meadows, bogs, fens, wetlands, vernal pools and springs.
[2] Low ground pressure track-laying machines such as feller bunchers and masticators.
[3] Rubber-tired skidders and track-laying tractors.
[4] RCA team is one or more of the following: Forest Service hydrologist, soil scientist, botanist, or aquatic biologist

1. Hazard trees within the mechanical exclusion zone may be hand felled away from the channel and SAFs. If logs can't be removed with full suspension, they will be left in place. Any portion of a felled tree outside of mechanical exclusion zone may be bucked and removed. Consultation will occur with the RCA Team for specific site exceptions.
2. Utilize conservative approaches to designate hazard trees within mechanical exclusion zones to retain as many standing trees as possible. If hazard trees must be removed from within the mechanical exclusion zone, leave a minimum of 10-20 pieces of large wood (standing and on ground) per 300 feet of stream length. Within the RCA outside of the mechanical exclusion zone, leave a minimum of 10-20 pieces of large wood (standing and on ground) per 300 feet of stream length. Large wood is defined as being a minimum of 10" in diameter and 10' in length. The largest trees should be retained, however a range of sizes should be included.
3. Within the RCAs, 70% post-implementation soil cover would be maintained when possible and dominated by material less than 3" in diameter. Application methods could include cutting and lopping, or mastication of pre-commercial material, cutting and scattering of activity material, non-whole tree harvesting methods, or mulch applications. Utilize on site biomass to generate mulch materials wherever possible.
4. New crossings on perennial or intermittent streams must be consulted upon with RCA Team. Number of crossing on ephemeral streams should not exceed 3 per mile.
5. No reforestation activities shall occur within 50 feet of riparian vegetation along perennial or intermittent streams or SAFs, or within 25 feet of ephemeral streams.
6. No herbicide treatments, with the exception of targeted invasive plant treatments, within 100 feet of perennials, intermittent, and SAFs and 25 feet of ephemerals.

Cultural Resources: following are measures designed to protect cultural resources sites.

1. Cultural resource sites will be designated on the ground prior to implementation of project activities to ensure their protection through avoidance and/or prescribed protection measures.
2. The Forest Service project administrator and/or archaeologist will field visit all cultural resource sites with the purchaser or contractor prior to start of project activities.
3. Felling and removal of hazard or salvage trees from within cultural resource site boundaries will follow the guidelines established in the 2013 Regional Programmatic Agreement Regarding Compliance with Section 106 of the National Historic Preservation Act, and will follow Heritage Program Manager approved guidelines in regards to use of equipment within site boundaries.
4. Prescribed burning and related fuels management activities within cultural resource site boundaries will also follow the guidelines established in the 2013 Regional Programmatic Agreement Regarding Compliance with Section 106 of the National Historic Preservation Act.
5. Cultural resource sites where implementation monitoring by an archaeologist is required to authorize and direct work within site boundaries will be identified on contract administrator maps, harvest cards, and/or burn plan maps to facilitate planning and scheduling of such work.
6. Directional felling methods will be utilized as appropriate to protect cultural resource sites.

7. Wildlife snag-retention patches will not be located within or immediately adjacent to cultural resource sites, whenever possible.
8. Proposed log landing areas and other staging areas need to be agreed upon with the archaeologist prior to use.
9. Should any previously unrecorded cultural resources be encountered during implementation of this project, all work should immediately cease in that area (within 150 feet) and the archeologist be notified immediately. Work may resume after approval by the archeologist, provided that any recommended standard protection measures are implemented.

References Cited

Angwin, P.A, Cluck D. R., Zambino, P. J. Oblinger, B. W and Woodruff, W.C. 2012. Hazard Tree Guidelines for Forest Service Facilities and Roads in the Pacific Southwest Region. Forest Health Protection, Region 5, Report #RO-12-01

Bohlman, G. 2014. Inventory and Monitoring of Current Vegetation Conditions, Forest Stand Structure, and Regeneration of Conifers and Hardwoods within the Freds Fire Boundary. Final Report. UC Davis.

Bonnet, V. H., A. W. Schoettle, and W. D. Shepperd. 2005. Postfire environmental conditions influence the spatial pattern of regeneration for Pinus ponderosa. Canadian Journal of Forest Research 35:37-47.

Churchill, D. J., A. J. Larson, M. C. Dahlgreen, J. F. Franklin, P. F. Hessburg, and J. A. Lutz. 2013. Restoring forest resilience: From reference spatial patterns to silvicultural prescriptions and monitoring. Forest Ecology and Management 291:442-457.

Collins, B.M. and S.L. Stephens. 2010. Stand-replacing patches within a 'mixed severity' fire regime: quantitative characterization using recent fires in a long-established natural fire area. Landscape Ecol DOI: 10.1007/s10980-010-9470-5. Pages 927-939.

Larson, A. J. and D. M. Churchill. 2012. Tree spatial patterns in fire-frequent forests of western North America, including mechanisms of pattern formation and implications for designing fuel reduction and restoration treatments. Forest Ecology and Management 267:74-92.

Lowell, Eine C., Susan A. Willits and Robert L. Krahmer. 1992. Deterioration of Fire-Killed and Fire-Damaged Timber in the Western United States. PNW-GTR-292. USDA Forest Service, Pacific Northwest Research Station.

North, M., Stine, P., O'Hara, K., Zielinski, W., and S. Stephens. 2009. An ecosystem strategy for Sierran mixed-conifer forests. Gen. Tech. Rep. PSW-GTR-220. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 49 p.

North, Malcom, ed. 2012. Managing Sierra Nevada Forests. Gen. Tech. Rep. PSW-GTR-237. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 184 p.

Smith, S.L. and D.R. Cluck. 2011. Marking guidelines for fire-injured trees in California. US Forest Service, Forest Health Protection, Region 5, Susanville, CA. Report # RO-11-01. 13 p.

USDA, Forest Service. 2004. Sierra Nevada Forest Plan Amendment: Final Supplemental Environmental Impact Statement, Vols. 1-2 and Record of Decision. U.S. Department of Agriculture, Forest Service, Pacific Southwest Region, Vallejo, California.

USDA, Forest Service. 2012. 2-Chaix Fuels Reduction and Forest Health Project Environmental Assessment and Decision Notice. Eldorado National Forest, Forest Service. Placerville, CA.

USDA, Forest Service. 2013. Forest-Wide Treatment of Invasive Plants Project Environmental Assessment and Decision Notice. Eldorado National Forest, Forest Service. Placerville, CA.